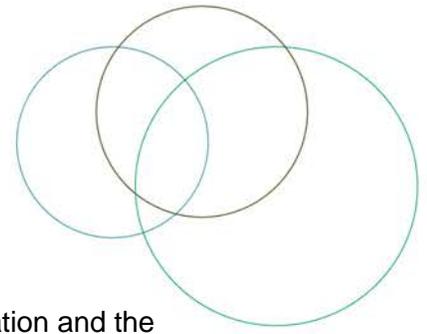


HOSPITAL HARM IMPROVEMENT RESOURCE

# Procedure-Associated Shock



## ACKNOWLEDGEMENTS



Canadian Institute  
for Health Information  
Institut canadien  
d'information sur la santé

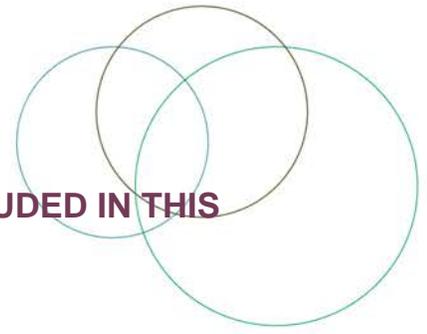


Canadian  
Patient  
Safety  
Institute  
Institut  
canadien  
pour la sécurité  
des patients

The Canadian institute for health information and the Canadian patient safety institute have collaborated on a body of work to address gaps in measuring harm and to support patient safety improvement efforts in Canadian hospitals.

The hospital harm improvement resource was developed by the Canadian patient safety institute to complement the hospital harm measure developed by the Canadian institute for health information. It links measurement and improvement by providing resources that will support patient safety improvement efforts.



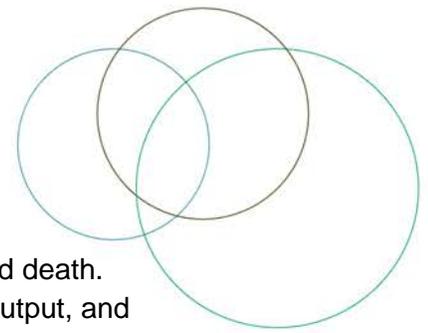


## DISCHARGE ABSTRACT DATABASE (DAD) CODES INCLUDED IN THIS CLINICAL CATEGORY:

### D25: Procedure-Associated Shock

<b>Concept</b>	Shock during or resulting from a procedure.
<b>Selection criteria</b>	
T81.1	Identified as diagnosis type (2) <b>AND</b> Y60-84 in the same diagnostic cluster
<b>Codes</b>	<b>Code descriptions</b>
T81.1	Shock during or resulting from a procedure, not elsewhere classified
<b>Additional Codes</b>	<b>Inclusions</b>
Y60-84	Complications of medical and surgical care (refer to Appendix A) of the <a href="#">Hospital Harm Indicator General Methodology Notes</a>





## OVERVIEW AND IMPLICATIONS

Shock is a state of organ hypoperfusion with resultant cellular dysfunction and death. Mechanisms may involve decreased circulating volume, decreased cardiac output, and vasodilation, sometimes with shunting of blood to bypass capillary exchange beds (Procter, 2020). It is a clinical state that occurs when a mismatch arises between oxygen supply and metabolic demand, resulting in cellular hypoxia. If not recognized and treated appropriately, shock will ultimately progress to organ failure (Broussard & Ural, 2018; Gaieski & Mikkelsen, 2018; Vincent & De Backer, 2013). It is one of the leading causes of death in hospitalized patients (Nichol & Ahmed, 2014).

There are several types of shock that a patient may experience during or after a procedure. Mechanisms of organ hypoperfusion and shock may be due to a low circulating volume (hypovolemic shock), vasodilation (distributive shock), a primary decrease in cardiac output (both cardiogenic and obstructive shock), or a combination of all of them. Untreated shock is usually fatal. Even with treatment, mortality from cardiogenic shock after myocardial infarction [MI] (60 to 65 per cent) and septic shock (30 to 40 per cent) is high. Prognosis depends on the cause, preexisting or complicating illness, time between onset and diagnosis, and promptness and adequacy of therapy (Procter, 2020).

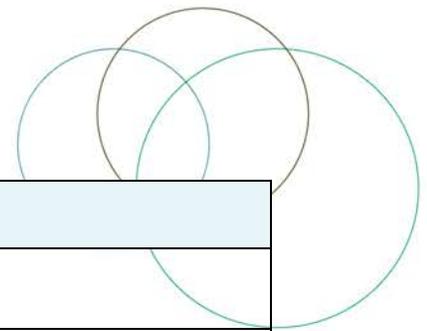
Organ dysfunction in patients can be represented by an increase in the Sequential Organ Failure Assessment (SOFA) score (Vincent et al., 1996) of two points or more, which is associated with an in-hospital mortality greater than 10 per cent. Patients with septic shock can be identified by a vasopressor requirement to maintain a mean arterial pressure of 65 mm Hg or greater AND serum lactate level greater than 2 mmol/L in the absence of hypovolemia (i.e. after adequate fluid resuscitation). This combination is associated with hospital mortality rates greater than 40 per cent (Singer et al., 2016).

Table 1 was created by Dr. Denny Laporta at the Jewish General Hospital, McGill University, Montreal, QC (Laporta, 2018). The table summarizes the various types of shock that may be encountered in the peri-procedure period. In *hypovolemic shock* the reduced cardiac output is due to a reduction in circulating volume and consequent venous return. It may be due to hemorrhage or when large volumes of fluid are lost perioperatively – expectedly or unexpectedly.

**Table 1: Examples of shock<sup>1</sup> occurring during or after a procedure**

Peri-Procedure Period	Type of shock	Causes
<b>Hypovolemic</b>	Bleeding	<ul style="list-style-type: none"> <li>• Excess loss of non-blood fluid               <ul style="list-style-type: none"> <li>○ Drainage</li> <li>○ 3<sup>rd</sup>-spacing</li> </ul> </li> </ul>
<b>Cardiogenic</b>	Myocardial Infarction	<ul style="list-style-type: none"> <li>• Pre-existing               <ul style="list-style-type: none"> <li>○ Cardiomyopathy (hypertrophic dilated)</li> <li>○ Valvulopathy</li> </ul> </li> </ul>





Peri-Procedure Period	Type of shock	Causes
<b>Obstructive</b>	Pulmonary embolism	<ul style="list-style-type: none"> <li>• Tension pneumothorax</li> <li>• Cardiac tamponade</li> </ul>
<b>Distributive</b>	Septic syndrome	<ul style="list-style-type: none"> <li>• Other (non-infectious) causes of systemic inflammatory response (SIRS):                             <ul style="list-style-type: none"> <li>○ Anaphylaxis</li> <li>○ Transfusion reaction</li> </ul> </li> <li>• Other adverse drug reactions:                             <ul style="list-style-type: none"> <li>○ Antihypertensives</li> <li>○ Anesthetics</li> </ul> </li> <li>• Spinal shock (neuraxial blockade)</li> <li>• Adrenal insufficiency (chronic steroid use)</li> <li>• Miscellaneous                             <ul style="list-style-type: none"> <li>○ Burns</li> <li>○ Liver failure</li> <li>○ Thyroid storm</li> </ul> </li> </ul>

<sup>1</sup>These may occur as single causes or in combination

## GOAL

Reduce the incidence of procedure-associated shock.

## IMPORTANCE FOR PATIENTS AND FAMILIES

Procedure related shock can cause serious harm and death if not treated quickly. Knowing the signs to watch for, along with a prompt and appropriate response, can help save lives.

Family members will often identify changes in the patient’s alertness and level of awareness, as well as the patient’s restlessness and agitation. Deterioration may not be recognized or acted upon by healthcare providers, resulting in preventable patient safety incidents. Monitoring, observation, family consultation and communication are key to managing this risk (HIROC, 2020).

### Patient Stories

Hear, and feel free to share Erin’s and Jen’s powerful stories via “Sepsis Emergency™” as provided by the Sepsis Alliance (Sepsis Alliance, 2014).

<https://www.youtube.com/watch?v=DnsQ4RIXsZY>

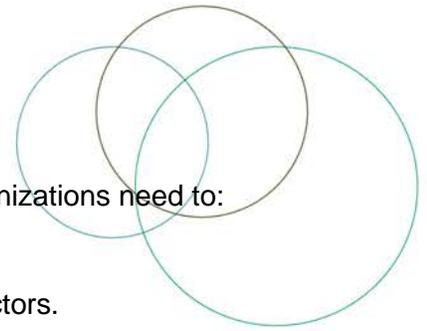
## CLINICAL AND SYSTEM REVIEWS, INCIDENT ANALYSES

Given the broad range of potential causes of Procedure-Associated Shock, clinical and system reviews should be conducted to identify latent causes and determine appropriate recommendations.



## HOSPITAL HARM IMPROVEMENT RESOURCE

### Procedure-Associated Shock



Occurrences of harm are often complex with many contributing factors. Organizations need to:

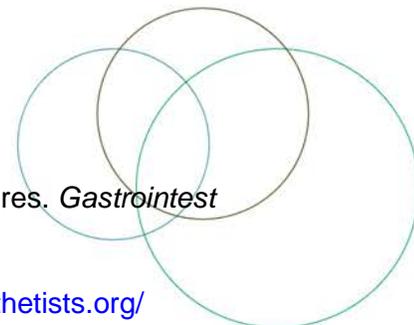
1. Measure and monitor the types and frequency of these occurrences.
2. Use appropriate analytical methods to understand the contributing factors.
3. Identify and implement solutions or interventions that are designed to prevent recurrence and reduce risk of harm.
4. Have mechanisms in place to mitigate consequences of harm when it occurs.

To develop a more in-depth understanding of the care delivered to patients, chart audits, incident analyses and prospective analyses can be helpful in identifying quality improvement opportunities. Links to key resources for [conducting chart audits](#) and [analysis methods](#) are included in the [Hospital Harm Improvement Resource Introduction](#).

If your review reveals that your cases of Procedure-Associated Shock are linked to specific processes or procedures, you may find these resources helpful:

- Agency for Healthcare Research and Quality [www.ahrq.gov](http://www.ahrq.gov)
  - AHRQ. Introduction to the toolkit for using the AHRQ quality indicators: How to improve hospital quality and safety. AHRQ; 2013. Available at: [https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/qito/olkit/combined/combined\\_toolkit.pdf](https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/qito/olkit/combined/combined_toolkit.pdf)
  - Agency for Healthcare Research and Quality (AHRQ). *PSI (Patient Safety Indicator) 09: Postoperative hemorrhage or hematoma. Selected best practices and suggestions for improvement*. AHRQ; 2013. Available at: [https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/qito/olkit/combined/d4f\\_combo\\_psi09-postophemorrhage-bestpractices.pdf](https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/qito/olkit/combined/d4f_combo_psi09-postophemorrhage-bestpractices.pdf)
- American Academy of Orthopaedic Surgeons (AAOS) [www.aaos.org](http://www.aaos.org)
  - Preventing venous thromboembolic disease in patients undergoing elective hip and knee arthroplasty: Evidence-based guideline and evidence report. 2nd edition. Rosemont, IL; AAOS: 2011. [https://www.aaos.org/globalassets/quality-and-practice-resources/vte/vte\\_full\\_guideline\\_10.31.16.pdf](https://www.aaos.org/globalassets/quality-and-practice-resources/vte/vte_full_guideline_10.31.16.pdf)
- American College of Surgeons <https://www.facs.org/>
  - American College of Surgeons. ATLS® Advanced Trauma Life Support® 10th Edition <https://viaaerearcp.files.wordpress.com/2018/02/atls-2018.pdf>
- American Society of Anesthesiologists, Standards and Guidelines <https://www.asahq.org/standards-and-guidelines>
- American Society for Gastrointestinal Endoscopy (ASGE) Guidelines <https://www.asge.org/home/practice-support/guidelines>
  - Anderson MA, Ben-Menachem T, Gan SI, et al. American Society of Gastrointestinal Endoscopy (ASGE) Standards of Practice Committee.





Management of antithrombotic agents for endoscopic procedures. *Gastrointest Endosc.* 2009; 70(6):1060-70. doi: 10.1016/j.gie.2009.09.040.

- Association of Anaesthetists of Great Britain and Ireland <https://anaesthetists.org/>
  - Association of Anaesthetists of Great Britain and Ireland, Thomas D, Wee M, et al. Blood transfusion and the anaesthetist: management of massive haemorrhage. *Anaesthesia.* 2010; 65 (11): 1153-1161. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3032944/>
- Blood Transfusion
  - Theusinger, O. M., Kind, S. L., Seifert, B., Borgeat, L., Gerber, C., Spahn, D. R. (2014). Patient blood management in orthopaedic surgery: a four-year follow-up of transfusion requirements and blood loss from 2008 to 2011 at the Balgrist University Hospital in Zurich, Switzerland. *Blood Transfusion*, 12, 195-203. <https://dx.doi.org/10.2450/2014.0306-13> Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4039701/>
- British Journal of Haematology <https://onlinelibrary.wiley.com/journal/13652141>
  - Hunt BJ, Allard S, Keeling David, et al. A practical guideline for the haematological management of major haemorrhage. *Br J Haematol.* 2015; 170 (6): 788-803. doi: 10.1111/bjh.13580. Available at: <https://onlinelibrary.wiley.com/doi/abs/10.1111/bjh.13580>
- Clinical Obstetrics and Gynecology <https://journals.lww.com/clinicalobgyn/pages/default.aspx>
  - Yu, S. P., Cohen, J. G., Parker, W. H. (2015). Management of hemorrhage during gynecologic surgery. *Clinical Obstetrics & Gynecology*, 58, 718-31. <https://dx.doi.org/10.1097/GRF.0000000000000147>
- Critical Care Clinics [www.criticalcare.theclinics.com](http://www.criticalcare.theclinics.com)
  - Cantle PM, Cotton BA. Prediction of massive transfusion in trauma. *Crit Care Clin.* 2017; 33(1): 71-84. doi: 10.1016/j.ccc.2016.08.002
- Current Opinion in Anesthesiology <https://journals.lww.com/co-anesthesiology/pages/default.aspx>
  - Butwicka AJ, Goodnough LT. Transfusion and coagulation management in major obstetric hemorrhage. *Curr Opin Anesthesiol* 2015, 28:275–284. doi: 10.1097/ACO.0000000000000180. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4567035/>
- ERAS (Enhanced Recovery After Surgery) Society Guidelines <http://erassociety.org/guidelines/list-of-guidelines/>
  - Kozek-Langenecker SA, Ahmed AB, Afshari A, et al. Management of severe peri-operative bleeding: guidelines from the European Society of Anaesthesiology: First update 2016. *European Journal of Anaesthesiology | EJA.* 2017;34(6). doi:10.1097/EJA.0000000000000630



## HOSPITAL HARM IMPROVEMENT RESOURCE

### Procedure-Associated Shock

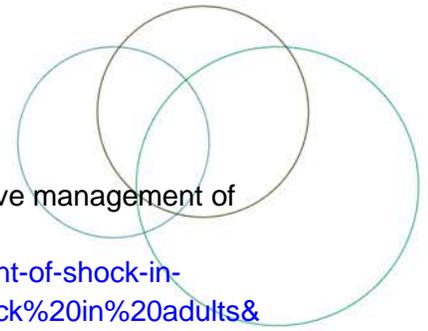


- European Society of Intensive Care Medicine <https://www.esicm.org>
  - Cecconi M, De Backer D, Antonelli M, et al. Consensus on circulatory shock and hemodynamic monitoring. Task force of the European Society of Intensive Care Medicine. *Intensive Care Med.* 2014;40(12):1795-1815. doi:[10.1007/s00134-014-3525-z](https://doi.org/10.1007/s00134-014-3525-z)
- Institute for Healthcare Improvement (IHI) [www.ihl.org](http://www.ihl.org)
  - Institute for Healthcare Improvement (IHI). *How-to guide: Prevent harm from high-alert medications*. Cambridge, MA: IHI; 2012. <http://www.ihl.org/resources/Pages/Tools/HowtoGuidePreventHarmfromHighAlertMedications.aspx>
- Journal of Emergency Trauma Shock [www.onlinejets.org/](http://www.onlinejets.org/)
  - Balvers K, Coppens M, van Dieren S, et al. Effects of a hospital-wide introduction of a massive transfusion protocol on blood product ratio and blood product waste. *J Emerg Trauma Shock.* 2015;8(4):199-204. doi:[10.4103/0974-2700.166597](https://doi.org/10.4103/0974-2700.166597)
- Merck Manual Professional Version [www.merckmanuals.com](http://www.merckmanuals.com)
  - Procter LD. Shock. Merck Manuals Professional Edition. Merck Manuals Professional Edition. Published October 2020. Accessed March 2021. <https://www.merckmanuals.com/professional/critical-care-medicine/shock-and-fluid-resuscitation/shock>
- National Institute for Health and Care Excellence (NICE) [www.nice.org.uk](http://www.nice.org.uk)
- New England Journal of Medicine [www.nejm.org](http://www.nejm.org)
  - Vincent J-L, De Backer D. Circulatory Shock. *N Engl J Med.* 2013;369(18):1726-1734. doi:[10.1056/NEJMra1208943](https://doi.org/10.1056/NEJMra1208943)
- Royal College of Anaesthetists [www.rcoa.ac.uk](http://www.rcoa.ac.uk)
- Seminars in Thrombosis and Hemostatsis
  - James AH, Grotegut C, Ahmadzia H, Peterson-Layne C, Lockhart E. Management of Coagulopathy in Postpartum Hemorrhage. *Semin Thromb Hemost.* 2016;42(7):724-731. doi:[10.1055/s-0036-1593417](https://doi.org/10.1055/s-0036-1593417)
- Society of Critical Care Medicine <https://www.sccm.org/Research/Journals/Critical-Care-Medicine>
  - Rhodes A, Evans LE, Alhazzani W, et al. Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016. *Crit Care Med.* 2017;45(3). doi:[10.1097/CCM.0000000000002255](https://doi.org/10.1097/CCM.0000000000002255)
- UPTODATE [www.uptodate.com](http://www.uptodate.com)
  - Gaieski DF, Mikkelsen ME. Evaluation of and initial approach to the adult patient with undifferentiated hypotension and shock. *UpToDate.* 2018 October, last updated. <https://www.uptodate.com/contents/evaluation-of-and-initial-approach-to-the-adult-patient-with-undifferentiated-hypotension-and-shock>



## HOSPITAL HARM IMPROVEMENT RESOURCE

### Procedure-Associated Shock



- Hrymak C, Funk DJ, O'Connor MF, Jacobsohn E. Intraoperative management of shock in adults. *UpToDate*. 2018 July, last updated. [https://www.uptodate.com/contents/intraoperative-management-of-shock-in-adults?search=Intraoperative%20management%20of%20shock%20in%20adults&source=search\\_result&selectedTitle=1~150&usage\\_type=default&display\\_rank=1](https://www.uptodate.com/contents/intraoperative-management-of-shock-in-adults?search=Intraoperative%20management%20of%20shock%20in%20adults&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1)
- Parker WH, Wagener WH. Management of hemorrhage in gynecologic surgery. *UpToDate*. 2018 May, last updated. <https://www.uptodate.com/contents/management-of-hemorrhage-in-gynecologic-surgery>
- Siparsky N. Overview of postoperative fluid therapy in adults. *UpToDate*. 2018 May, last updated. <https://www.uptodate.com/contents/overview-of-postoperative-fluid-therapy-in-adults>
- For additional references you may also find the following Hospital Harm Improvement Resources helpful:
  - [Obstetric Hemorrhage](#)
  - [Venous Thromboembolism](#)
  - [Electrolyte and Fluid Imbalance](#)
  - [Sepsis](#)
  - [Anemia - Hemorrhage \(Procedure-Associated Condition\)](#)

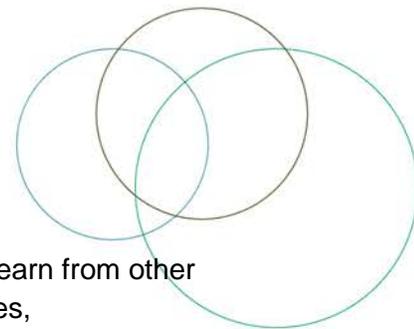
## MEASURES

Vital to quality improvement is measurement, and this applies specifically to implementation of interventions. The chosen measures will help to determine whether an impact is being made (primary outcome), whether the intervention is being carried out (process measures), and whether any unintended consequences ensue (balancing measures).

In selecting your measures, consider the following:

- Whenever possible, use measures you are already collecting for other programs.
- Evaluate your choice of measures in terms of the usefulness of the results and the resources required to obtain them; try to maximize the former while minimizing the latter.
- Try to include both process and outcome measures in your measurement scheme.
- You may use different measures or modify the measures to make them more appropriate and/or useful to your setting. However, be aware that modifying measures may limit the comparability of your results to others.
- Posting your measure results within your hospital is a great way to keep your teams motivated and aware of progress. Try to include measures that your team will find meaningful and exciting (IHI, 2012).





## GLOBAL PATIENT SAFETY ALERTS

[Global Patient Safety Alerts](#) (GPSA) provides access and the opportunity to learn from other organizations about specific patient safety incidents including alerts, advisories, recommendations, and solutions for improving care and preventing incidents. Learning from the experience of other organizations can accelerate improvement (CPSI, n.d.).

### Recommended search terms:

- Hemorrhage
- Sepsis
- Shock

## PROCEDURE-ASSOCIATED SHOCK SUCCESS STORY

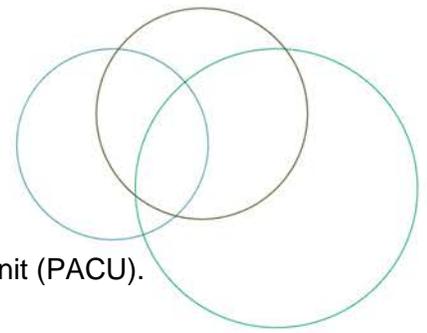
### Surviving Sepsis

In April 2008, a 70-year-old independent lady with no previous comorbidities became a grandmother for the first time and was looking forward to watching her family grow-up. She developed a cough' became breathless and presented to her local hospital. She was admitted and developed severe sepsis and septic shock secondary to her community-acquired pneumonia; she died within seven hours. Her sepsis was not recognized, and antibiotics and fluids were not given in a timely manner. The patient's family and the well-meaning and competent medical and nursing team were devastated.

So begins the account of a real patient story that compelled Dr. Matt Inada-Kim and colleagues to tackle the problem of managing sepsis within their practice (Patient Stories, 2020).

<https://www.patientstories.org.uk/recent-posts/surviving-sepsis-a-human-factors-approach/>





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- Singer M, et. al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *Journal of the American Medical Association*. 2016; 315 (8): 801-810.
- Vincent JL, De Backer D. Circulatory shock. *N Engl J Med*. 2013; 369 (18): 1726-1734. doi: 10.1056/NEJMra1208943. Available at: [https://www.nejm.org/doi/10.1056/NEJMra1208943?url\\_ver=Z39.88-2003&rfr\\_id=ori%3Arid%3Acrossref.org&rfr\\_dat=cr\\_pub%3Dwww.ncbi.nlm.nih.gov&](https://www.nejm.org/doi/10.1056/NEJMra1208943?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dwww.ncbi.nlm.nih.gov&)

